1

1

2

3

What is claimed is:

- 1. A method for determining configuration parameters describing a physical
- 2 system, the method comprising the steps of
- measuring an output signal from the system in response to an input signal,
- 4 the output signal being related to the configuration parameters by a linear operator, and
- 5 directly reconstructing each of the configuration parameters by applying a
- 6 prescribed mathematical algorithm to the output signal.
 - 2. The method as recited in claim 1 wherein said step of directly reconstructing includes the step of computing a configuration parameter function.
 - 3. The method as recited in claim 1 wherein said step of directly reconstructing includes the step of computing a configuration kernel.
 - 4. The method as recited in claim 1 wherein said step of directly reconstructing includes the step of computing a configuration parameter response function for each of the configuration parameters.
- 5. A method for estimating a loop composition in terms of loop parameters
- 2 representative of the loop composition comprising the steps of
- energizing the loop from a measurement end with an energy source,
- 4 measuring a response signal from the loop at the measurement end,
- wherein each of the loop parameters is related to response signal by a linear operator, and

- directly reconstructing each of the loop parameters by executing a
- 2 prescribed mathematical algorithm, determined with reference to the linear operator, on
- 3 the response signal.
- 6. The method as recited in claim wherein said step of directly reconstructing includes the step of computing a loop parameter function.
 - 7. The method as recited in claim 5 wherein said step of directly reconstructing includes the step of computing a loop kernel.
 - 8. The method as recited in claim 5 wherein said step of directly reconstructing includes the step of computing a parameter response function for each of the loop parameters.
 - 9. A method for estimating a loop composition of a subscriber loop in terms of loop parameters $X_1, X_2, ..., X_i, ..., X_N$, the loop having a frequency-domain response
- 3 $H(\omega, X_1, X_2, ..., X_i, ..., X_N)$ for the loop parameters, the method comprising the steps of
- 4 (a) determining a range for each loop parameter X_i,
- 5 (b) for each loop parameter X_i, generating a frequency-domain loop
- 6 parameter function $F_{X_i}(\omega)$ wherein

7
$$F_{X_i}(\omega) = \int_{X_1 X_2} \dots \int_{X_i} \dots \int_{X_i} X_i H(\omega, X_1, X_2, \dots, X_i, \dots, X_N) dX_1 dX_2 \dots dX_i \dots dX_N,$$

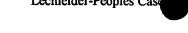
8 (c) generating a loop kernel $k(\omega, \beta)$ for all loop parameters wherein

2

3

1

2



- 1 $k(\omega, \beta) = \int_{X_1 X_2 \dots X_N} H(\omega, X_1, X_2, \dots, X_N) H(\beta, X_1, X_2, \dots, X_N) dX_1 dX_2 \dots dX_N,$
- 2 (d) generating a parameter response function $g_i(\beta)$ for each loop
- parameter from the integral relation $F_{k_i}(\omega) = \int_{\beta} k(\omega, \beta) g_i(\beta) d\beta$,
- 4 (e) energizing the loop from a measurement end with an energy source,
- (f) measuring a response signal $H_R(\omega) = H(\omega, X_1, X_2, ..., X_i, ..., X_N)$
- for the loop at the measurement end, and
 - (g) directly determining each loop parameter Xi from the integral relation
- $8 X_i = \int_{\beta} H_R(\beta) g_i(\beta) d\beta.$
- 1 10. The method as recited in claim 9 wherein step (e) includes the step of computing the inverse of $k(\omega, \beta)$.
 - 11. The method as recited in claim 9 wherein step (e) includes the step of computing the inverse of $k(\omega, \beta)$ using singular value decomposition.
- 1 12. The method as recited in claim 11 wherein step (f) includes the step of filtering
- 2 noise from the response signal.
- 1 13. A system for generating the loop composition in terms of loop parameters
- 2 representative of the loop composition comprising
- a source of waves for energizing the loop from a measurement end,

1

2

1

- a detector for detecting a response signal from the loop at the measurement
- end, wherein each of the loop parameters is related to response signal by an integral
- 3 operator, and
- a reconstructor for directly reconstructing each of the loop parameters by
- 5 executing a prescribed mathematical algorithm, determined with reference to the integral
- 6 operator, on the response signal.
 - 14. The system as recited in claim 13 wherein said reconstructor includes a
- 2 processor for computing a loop parameter function.
- 1 15. The system as recited in claim 13 wherein said reconstructor includes a
- 2 processor for computing a loop kernel.
- 1 16. The system as recited in claim 13 wherein said reconstructor includes a
- 2 processor for computing a parameter response function for each of the loop parameters.